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CHEMICAL COMPOSITION AND I*N VITRO* FERMENTATION CHARACTERISTICS OF ENSILED CASSAVA (*Manihot esculentus*, Crantz) TOPS AND GUINEA GRASS MIXTURE

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ABSTRACT
Cassava tops and Guinea grass was ensiled with four energy additive(cassava chips, Sorghum, millet grains and sugar) in five treatments -: treatments A (30% Cassava tops + 60% Guinea grass +10 % cassava chips), B (30 % Cassava tops + 60% Guinea grass+10 % Sorghum), C (30 % Cassava tops + 60% Guinea grass+ 10% millet grains, D (30 % Cassava tops + 60% Guinea grass+ 10 % sugar) and E (40 % Cassava tops + 60% Guinea grass + 0% additive) for 42days. Chemical composition and In vitro gas production were determined. Gas production ranged from 23.5 -29 ml / 48h. Highest ($P< 0.05$) and lowest gas production were obtained with treatment C and D respectively. Methane (ml /200 mg Dm) production ranged from 11.5 -23, the highest being from treatment C and the least from Treatment A.

KEYWORDS: *Manihot esculenta*, season crop, livestock, water soluble carbohydrates, Nigeria

INTRODUCTION

Cassava (*Manihot esculenta*, Crantz) is an all season crop grown as food for human in several parts of Nigeria, suggesting abundant of its leaf as crop residue. These leaves are left in the field as green manure, but can also be used as feed for livestock. Numerous studies have shown that the protein in cassava leaves is more than 20% in DM basis (Ravindran 1991; Oduguwa *et al.*,2007). However, there is a significant variation in nutrient content between seasons of growing (AFRIS 2004), cassava varieties, stage of maturity (Ravindran and Ravindran 1988) and soil fertility. Fresh cassava leaf is bulky, quickly wilts, perishable and decays, necessitating conservation. Ensiling could be a suitable way of preserving the leaves but silage additives should be added to ensure successful fermentation when the ensiled material, such as cassava tops, has a high content of nitrogen and low concentration of water soluble carbohydrates (Petersson 1988).

The *in vitro* gas production method is accurate and predicts feed intake, digestibility, microbial nitrogen supply and animal performance (Blummel and Ørskov, 1993). For the past two decades, the technique had been used in advanced countries as an instrument to determine the amount of short chain fatty acids, carbon dioxide and metabolizable energy of feed for ruminants (Blummel and Becker, 1997; Getachew *et al*., 1999). The objective of this study was to investigate the proximate composition and *In vitro* gas production of ensiled cassava tops and Guinea grass mixture with different additives.

MATERIALS AND METHODS

The experiment was carried out at the Small ruminant unit of the Teaching and Research Farm, University of Ibadan, Nigeria. Cassava tops were collected at post-harvest from commercial farms around Ibadan and two (2) months regrowth of Guinea grass was used. Chopped and wilted for 12 hour over night. Four energy additives were used which include; cassava chips, Sorghum grain, Millet and sugar; comprising five treatments: A (30% Cassava tops + 60% Guinea grass +10 % cassava chips), B (30 % Cassava tops + 60 % Guinea grass+10 % Sorghum); C (30 % Cassava tops + 60% Guinea grass+ 10% millet grains); D (30 % Cassava tops + 60% Guinea grass+ 10 % sugar) and E (40 % Cassava tops + 60% Guinea grass + 0% additive).Fermentation was done for 42 days. A representative sample of ensiled cassava top and Guinea grass were taken for dry mater determination (oven drying at 105 °C for) and other analysis. Crude protein, crude fibre, ether extract and ash contents of the samples were determined according to AOAC (1995). Neutral detergent fibre and acid detergent fibre were also assessed.

Rumen fluid was obtained from three West African dwarf female goats using the method of collection previously described (Babayemi and Bankole, 2006). The rumen liquor was collected into the thermo flask that had been pre-warmed to a temperature of 39ºC before the morning feed. Incubation was as reported (Menke and Steingass, 1988) using 120 ml calibrated syringes in three batch incubation at 39 ºC into 200 mg sample in the syringe was introduced 30 ml inoculums containing strained rumen liquor and buffer (1:2, v/v) under continuous flushing with CO_2. The gas production was measured at 6, 12, 18, 24, 36 and 48 h. At post incubation period, 4 ml of NaOH (10 M) was introduced to estimate methane production as reported by Fievez *et al*. (2005). The volume of the gas produced at intervals was plotted against the incubation time, and from the graph, the gas production characteristics were estimated using the equation $Y = a + b\ (1 – e^{-ct})$ described by Ørskov and McDonald (1979), where Y = volume of gas produced at time 't', a = intercept (gas produced from the soluble fraction), b = gas production from the insoluble fraction, c = gas production rate constant for the insoluble fraction (b), t = incubation time.

Statistical analysis

Metabolisable energy (ME) was calculated as ME= 2.20 + 0.136GV + 0.057 CP + 0.0029 CF (Menke ans Steingass, 1988). Organic matter digestibility (OMD %) was assessed as OMD = 14.88+ 0.889 GV + 0.45 CP + 0.651 XA . Short chain fatty acids (SCFA) as 0.0239 GV– 0.0601 (Getachew *et al*., 1998) was also obtained, where GV, CP, CF and XA are total gas volume (ml/200 mg DM), crude protein, crude fibre and ash, respectively. Data were analysed using analysis of variance (SAS, 1995). Significant means were separated using the Duncan (1955) multiple range F-test.

RESULTS AND DISCUSSION

Fig 1 shows the gas production of ensiled cassava foliage with Guinea grass incubated for 48 Hrs. The cumulative gas produced ranged between 23.50 and 29.00 ml/200 mg DM .There was significant variations in gas produced at 48h incubation time. The gas produced increased with increasing incubation time. The treatment C had the highest ($p < 0.05$) gas production at 12, 18, 24, 36 and 48h compared to treatment D.

Table 2 presents the *in vitro* fermentation parameters of ensiled cassava foliage with Guinea grass incubated for 48 Hrs. There were no significant ($p > 0.05$) differences in gas production rate ('c') and 'y' of the incubated samples. Significant variations ($p < 0.05$) however existed between ensiled samples in the value of insoluble fraction (b) and potential gas production (a+b), the highest being from treatment C (26.00, 29.50) and the least from treatment B (19.00 and 23.25) respectively. Methane production (fig 2) was highest in treatment C and lowest in treatment E. In most cases, feedstuffs that show high capacity for gas production are also observed to be synonymous for high methane production. Methane production in the rumen is an energetically wasteful process, since the portion of the animal's feed, which is converted to CH4, is eructated as gas.

Generally, gas production is a function and a mirror of degradable carbohydrate and therefore, the amount depends on the nature of the carbohydrates (Demeyer and Van Nevel, 1975; Blummel and Becker, 1997). The presence of FA in silages may also affect gas volume measurements in carbonate buffered in vitro measures, where about half of the gas volume is accounted for by CO2 released upon buffering SCFA (Blummel and Ørskov, 1993). The value for the ME, OMD and SCFA ranged from 6.66, 52.94 and 0.62 to 7.11, 58.18, and 0.77 respectively. Treatment c recorded the highest.

CONCLUSION

Results from the study showed that ensiled cassava tops and Guinea grass mixture with different additives have potential to benefit ruminant, especially during periods of scarcity

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Table 1: Chemical composition (%) of ensiled cassava tops and Guinea grass mixture

Treatment	DM	Crude protein	Crude fibre	Ash	Ether extract	NDF	ADF
60 % GG + 30 % CF+ 10% cassava chips	28.81	22.32	28.20	9.57	8.46	73.33	43.24
60 % GG + 30 % CF+ 10% Sorghum grain	27.05	22.42	29.14	8.51	8.46	71.45	45.13
60 % GG + 30 % CF+ 10% millet grain	28.82	24.15	28.30	9.54	10.38	76.41	40.57
60 % GG + 30 % CF+ 10% sugar	27.45	20.56	28.20	7.45	9.40	69.56	44.18
60 % GG + 40 % CF+ 0% additive	28.27	23.51	27.34	9.55	8.48	68.81	48.07

[abc]Means within the same column with different superscript, differ significantly (P< 0.05)
GG Guinea grass, CT Cassava tops

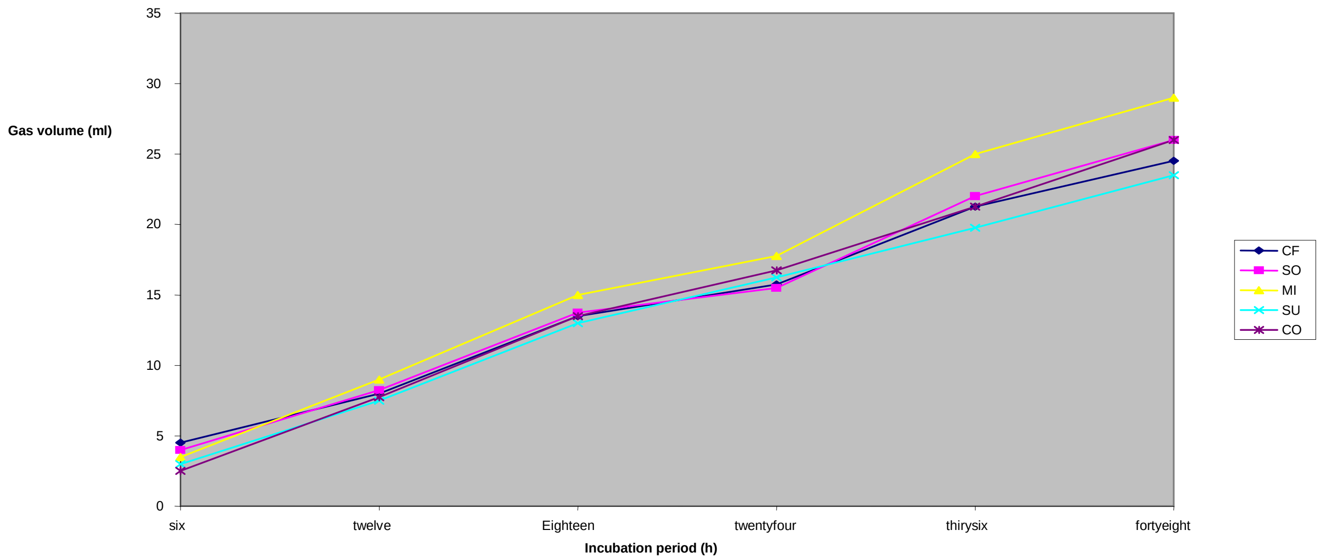

Fig 1: In vitro gas production of ensiled cassava tops and guinea grass mixture

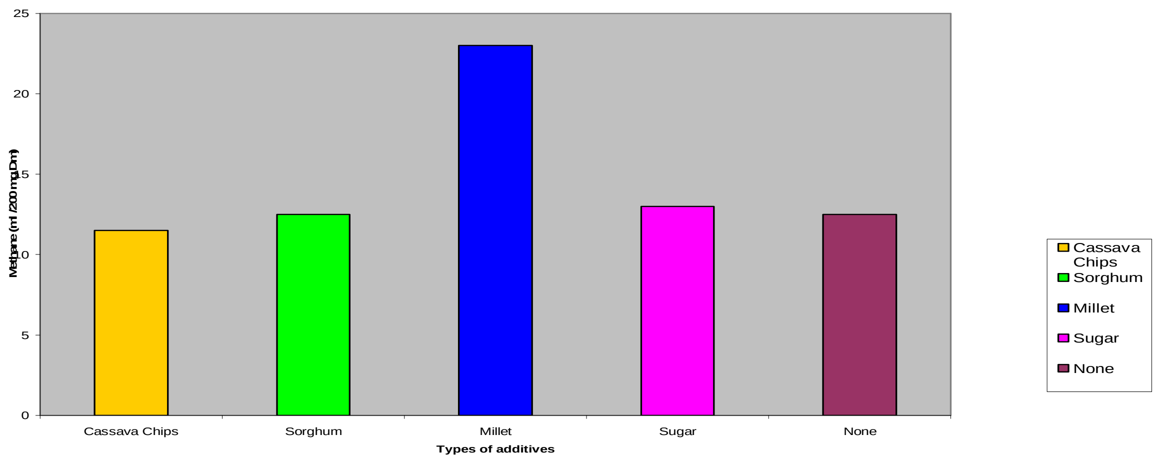

Fig 2:Methane (ml /200 mg Dm) production of ensiled Cassava tops and guinea grass mixture

Table 2: In vitro fermentation parameters of ensiled cassava foliage with Guinea grass incubated for 48 Hrs.

Treatments	B	a+b	C	Y	ME	OMD	SCFA
60 % GG + 30 % CF+ 10% cassava chips	19.75b[c]	24.50[b]	0.047	15.25	6.90[bc]	52.94[b]	0.65[b]
60 % GG + 30 % CF+ 10% Sorghum grain	19.00[c]	23.25[b]	0.036	13.00	7.11[b]	53.62[b]	0.68[b]
60 % GG + 30 % CF+ 10% millet grain	26.00[a]	29.50[a]	0.037	16.75	7.68[a]	58.18[a]	0.77[a]
60 % GG + 30 % CF+ 10% sugar	20.50b[c]	23.50[b]	0.062	14.25	6.66[c]	53.62[b]	0.62[b]
60 % GG + 40 % CF+ 0% additive	23.50[ab]	26.00[ab]	0.040	12.75	7.17[b]	54.79[b]	0.68[b]
SEM	0.67	0.60	0.009	1.21	0.14	0.90	0.02

[abc]Means within the same column with different superscript, differ significantly ($P< 0.05$) GG Guinea grass, CT Cassava tops

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